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NEW DELAWARE RECORDS FOR MAMMALIAN ECTOPARASITES, INCLUDING SIPHONAPTERA HOST LIST[1]

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The present study is a continuation of the ectoparasite work started by MacCreary (1945a) and Florschultz and Darsie (1960). Seven new species records and three new host records for Delaware were obtained from three species of mammalian hosts and an apparently abandoned poultry house. One species of mite was found for the first time on the white-footed mouse *Peromyscus leucopus noveboracensis* (Fischer). Detailed locality records for four additional ectoparasites are also included.

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Procedure

The ectoparasite recovery technique used in this study was modified from that of Race (1956). Sherman live traps, baited with apple or peanut butter, were employed in capturing the mammals alive. The rodents and shrews were all taken during the spring and fall of 1959. The live animal, once caught, was transferred from the trap to a clear plastic bag. Only one animal was placed in each bag.

Upon returning to the car the mouth of this bag was held firmly around the exhaust pipe, while the car engine was running. This rapidly asphyxiated its occupant. The animal was transferred immediately to a quart jar half filled with water and containing 4 to 5 drops of 25% lindane emulsifiable concentrate, and about one-half teaspoon of commercial detergent. The cap was replaced securely and the jar and contents shaken vigorously ten to twenty times. The plastic bag was resealed, labeled and placed with the jar.

The jar was agitated once again after returning to the laboratory; this time, however, it was shaken approximately a hundred times or more. The animal was removed and rinsed over a 60 mesh sieve, examined closely for remaining parasites, identified and discarded. The liquid and material in the jar was passed through the sieve and rinsed with clean water several times, each time pouring it through the sieve. The sieve was inverted and back-washed by water or alcohol into one or several watch glasses. The contents were inspected under a microscope and the parasites segregated. The mites were mounted immediately, while the lice and fleas were preserved in 70 percent alcohol to be processed and mounted later. The inside of the bag was examined for any parasites which might have left the host during its short stay therein.

The mites were mounted in Hoyer's solution and cleared over heat (Baker & Wharton, 1952). The Hoyer's solution plus the heat tended to relax the specimen and spread the legs, often a key feature in identification. The lice and fleas were cleared in 10% KOH, rinsed in three changes of distilled water, dehydrated in 50 percent then 100 percent ethyl cellosolve, and mounted directly in Canada balsam. The authors follow the classification of Class Mammalia by Hall and Kelson (1959).

Results

A total of 39 animals was examined for ectoparasites, all but one of which were taken from the Newark area of New Castle County.

The mammals were: one gray squirrel, *Sciurus carolinensis pennsylvanicus* Ord; six shorttailed shrews, *Blarina brevicauda talpoides* (Gapper); and 32 white-footed mice, *P. l. noveboracensis.* The gray squirrel was taken in Thompsonville, Kent County. In addition, eight fleas were collected from Hartly, Kent County, by Donald MacCreary in an abandoned poultry house, so that the host is unknown.

A total of 773 ectoparasites was recovered from the small mammals but it is doubtful that all of the parasites were removed from the hosts. One hundred and nineteen ticks were recovered but not included in this study since MacCreary (1945b) has already adequately treated this group.

Approximately one-half of the ectoparasites, other than ticks, were identified to species. These are listed in Table 1, including percent of hosts infested.

Acarina

Blarinobia simplex (Ewing).—Newark, New Castle Co., *ex B. b. talpoides,* 10 Nov. 1959, 1 ♀; 20 Nov. 1959, 9 ♀♀; ex *P. l. noveboracensis,* 11 Dec. 1959, 3 ♀♀ (E. Tindall). This comprises a new host record as well as a new State record for Delaware. Jameson (1948) described it from the soricid shrews, *B. brevicauda* and *Sorex cinereus* Kerr but not from *P. leucopus.* The original description of this genus and species was made by Jameson (1955). As far as the authors can determine, this is the first record of *B. simplex* occurring on white-footed mice. This mite appears to be specific for shrews and it may be an accidental infestation picked up in common runways. Jameson and Brennan (1957) noted that a variety of shrews, mice and other small mammals frequently utilized the same trails and tunnels in the turf and humus.

Euschongastia blarinae (Ewing).—Newark, New Castle Co., ex *B. b. talpoides,* 10 Nov. 1959, 1; 20 Nov. 1959, 7 (E. Tindall). Farrell (1956) described this mite and noted that all known collections of *E. blarinae* have been from shrews with but a single exception. That exception is the type specimen recorded from *P. leucopus,* the white-footed mouse. *E. blarinae* is a new record for Delaware.

Euschongastia peromysci (Ewing).—Newark, New Castle Co., ex *P. l. noveboracensis,* 18 Mar. 1959, 2; 19 Mar. 1959, 4; 20 Mar. 1959, 14; 24 Mar. 1959, 8; 26 Mar. 1959, 8; 6 Apr. 1959, 2; 8 Apr. 1959, 3; 9 Apr. 1959, 4; 11 Apr. 1959, 2; 13 Apr. 1959, 7; 19 Apr. 1959, 2; 20 Apr. 1959, 6; 21 Apr. 1959, 1; 22 Apr. 1959, 2; 23 Apr. 1959, 2; 28 Apr. 1959, 2; 4 May 1959, 3; 9 Dec. 1959, 11; 11 Dec.

Table 1. Numbers of Ectoparasites and Percent of Hosts Infested, Delaware, 1959*

Parasite	*Peromyscus leucopus*		*Blarina brevicauda*		*Sciurus carolinensis*		Total
	Total No.	Per. Hosts Infested	Total No.	Per. Hosts Infested	Total No.	Per. Hosts Infested	
ACARINA							
Blarinobia simplex	3	3	10	33			13
Euschongastia blarinae			8	33			8
E. peromysci	87	78					87
Hirstionyssus carnifex	2	3	2	17			4
Resinacarus spp.	2	6	1	17			3
Haemolaelaps glasgowi	38	53	2	17			40
ANOPLURA							
Hoplopleura hesperomydis	35	(adults) 41					35
	11	(nymphs) 9					11
SIPHONAPTERA							
Doratopsylla blarinae	2	6	32	83			34
Epitedia wenmanni	9	19					9
Orchopeas h. howardii					14	100	14
Orchopeas leucopus	36	38					36
Stenoponia americana	7	16					7
	232		55		14		301

* In addition, *Pulex i. irritans* was collected from an abandoned poultry house.

1959, 5 (E. Tindall). Farrell (1956) described this mite in detail and gave an extensive host list of shrews and rodents. Jameson and Brennan (1957) noted that this mite, though found throughout the year, was far less common during the summer months. They also considered this true for chiggers in general. According to these same authors, *E. peromysci* is most often found deep in the ear conch of its host. They found it much more common on forest inhabiting *Peromyscus* as compared with a brushfield habitat. Our mice were all trapped in hardwood forest. This chigger is also a new record for Delaware.

Haemolaelaps glasgowi (Ewing).—Newark, New Castle Co., ex *B. b. talpoides,* 6 Apr. 1959, 2 ♀♀; ex *P. l. noveboracensis,* 16 Mar. 1959, 12 ♀♀, 1 nymph; 19 Mar. 1959, 2 ♀♀; 20 Mar. 1959, 2 ♀♀; 26 Mar. 1959, 1 ♀; 6 Apr. 1959, 1 ♀; 8 Apr. 1959, 1 ♀; 9 Apr. 1959, 1 ♀; 11 Apr. 1959, 1 ♀; 13 Apr. 1959, 1 ♀; 19 Apr. 1959, 2 ♀♀; 20 Apr. 1959, 2 ♀♀; 22 Apr. 1959, 1 ♂; 24 Apr. 1959, 2 ♀♀; 4 May 1959, 3 ♀♀; 9 Dec. 1959, 3 ♀♀; 11 Dec. 1959, 1 ♀, 1 ♂ (E. Tindall). Florschutz and Darsie (1960) listed records from *Microtus pennsylvanicus* (Ord) and *P. leucopus.*

Hirstionyssus carnifex (Koch).—Newark, New Castle Co., ex *B. b. talpoides,* 12 Apr. 1959, 2 ♀♀; ex *P. l. noveboracensis,* 13 Apr. 1959, 2 ♀♀ (E. Tindall). Baker et al (1956) stated that this mite has been reported as a parasite from bats and rodents in the United States, Europe, Africa and Asia. This is the first record from Delaware.

Resinacarus spp.—Newark, New Castle Co., ex *P. l. noveboracensis,* 13 Apr. 1959, 1; 19 Apr. 1959, 1; ex *B. b. talpoides,* 10 Nov. 1959, 1; (E. Tindall). Evans and Freeman (1950) noted some species of Tyroglyphinae were taken from fleas; their presence being a case of transportation rather than one of feeding on the fleas. Two of the three recoveries of *Resinacarus* in the present study were in association with the fleas *O. leucopus* and *D. blarinae.* Baker and Wharton (1952) briefly mentioned this genus in their discussion of Pyemotidae. Both Tyroglyphinae and Pyemotidae are free living families, often infesting grain. It is therefore quite possible that this mite is not an ectoparasite. They also stated that the genus is little known and apparently of no economic importance. It is a new record for Delaware.

Anoplura

Hoplopleura hesperomydis (Osborn).—Newark, New Castle Co., ex *P. l. noveboracensis,* 18 Mar. 1959, 1 ♀, 1 ♂; 6 Apr.

1959, 1 ♀, 1 ♂; 13 Apr. 1959, 6 ♀♀, 1 ♂, 2 nymphs; 13 Apr. 1959, 1 ♀; 19 Apr. 1959, 2 ♀♀, 1 ♂; 20 Apr. 1959, 1 ♀, 1 ♂; 21 Apr. 1959, 3 ♀♀, 1 ♂; 22 Apr. 1959, 1 ♂; 9 Dec. 1959, 1 nymph; 11 Dec. 1959, 8 ♀♀, 4 ♂♂, 8 nymphs (E. Tindall). MacCreary (1945a) found *Hoplopleura acanthopus* (Burmeister) parasitizing *P. leucopus* in Delaware, though Ferris (1951), listed only *H. hesperomydis* from this host. Race (1956) also recorded it from *P. leucopus* in New Jersey, as well as *B. brevicauda, M. pennsylvanicus* and *M. pinetorum.* Cook and Beer (1959) reported this species from *P. leucopus* and *Peromyscus maniculatus* (Wagner) in the west and midwest. This is a new parasite record for Delaware.

Siphonaptera

Doratopsylla blarinae C. Fox.—Brenford, Kent County, ex shrew, 23 Apr. 1939, 1 ♂ (D. MacCreary); Camden, Kent Co., ex shrew, July, 1939, 1 ♀ (R. Smith); Newark, New Castle County, ex *B. b. talpoides,* 6 Apr. 1959, 4 ♀♀; 12 Apr. 1959, 2 ♀♀, 5 ♂♂; 15 Apr. 1959, 2 ♀♀, 9 ♂♂; 28 Apr. 1959, 5♀♀, 3 ♂♂; 10 Nov. 1959, 2 ♂♂; ex *P. l. noveboracensis,* 8 Apr. 1959, 1 ♂; 20 Apr. 1959, 1 ♀ (E. Tindall). Fox (1940) recorded *D. blarinae* from *P. leucopus.* MacCreary (1945a) found it on *B. brevicauda* while Burbutis (1956) collected it from *B. brevicauda* and *Microtus pinetorum* (Le Conte). Geary (1959) listed it from a number of soricid shrew species in New York. *P. leucopus* is a new host record for this flea in Delaware.

Ctenophthalmus pseudagyrtes Baker.—Sandtown, Kent Co., ex Pine mouse, 17 May 1939, 1 ♀; Willow Grove, Kent Co., ex Pine mouse, Kent Co., 23 June 1939, 2 ♀♀, 2 ♂♂ (MacCreary); 27 June 1939, 1 ♀, 1 ♂; 3 Aug. 1939, 1 ♂. MacCreary (1945a) reported this species of flea taken from *B. brevicauda, M. p. pennsylvanicus, P. l. leucopus,* and *Sylvilagus floridanus malluras* (Thomas). Fox (1940) gave an extensive host list and noted that it was one of the most abundant of the flea parasites of small mammals. He also stated that it often occurs in company with *D. blarinae* as a parasite of shrews but that its favored host is probably the mole. Burbutis (1956) reported it for the first time from the Virginia opossum, *Didelphis marsupialis virginiana* Kerr.

Epitedia wenmanni (Rothschild).—Hockessin, New Castle Co., ex white-footed mouse, 29 Dec. 1939, 1 ♀; ex *M. pennsylvanicus,* 13 Feb. 1940, 1 ♂ (MacCreary); Newark, New Castle Co., ex *P. l. noveboracensis,* 18 Mar. 1959, 2 ♀♀; 19 Mar. 1959, 1 ♀; 26 Mar. 1959, 1 ♀, 1 ♂; 9 Apr. 1959, 1 ♀; 21 Apr. 1959, 2 ♀♀, 1 ♂;

11 Dec. 1959, 1 ♀ (E. Tindall). Fox (1940) stated that this flea seems to be pre-eminent on the white-footed mouse, but is also abundant on many small mammals and may be found in the adult stage during practically every month of the year. MacCreary (1945a) reported this flea from *P. leucopus.* Jameson and Brennan (1957) noted that *E. wenmanni* is typical of deer mice as well as microtine rodents and seems to be a spring flea. This appears to hold true for the Delaware collections. Burbutis (1956) found it on *P. leucopus, B. brevicauda, M. pennsylvanicus, M. pinetorum* and the "skunk." Geary (1959) also listed *Mustela erminea cicognanii* Bonaparte, *Peromyscus maniculatus gracilis* (Le Conte), *Clethrionomys gapperi gapperi* (Vigors), *Tamiasciurus hudsonicus loguax* (Bangs), the opossum, the cottontail, and the hairy-tailed mole as hosts of this flea.

Orchopeas leucopus (Baker).—Kent Co., ex pine mouse, 23 June 1939, 1 ♂; 21 July 1939, 2 ♀♀ (D. MacCreary); ex *P. l. noveboracensis,* 18 Mar. 1959, 2 ♀♀, 1 ♂; 19 Mar. 1959, 1 ♀; 20 Mar. 1959, 1 ♀; 26 Mar. 1959, 1 ♀; 9 Apr. 1959, 2 ♀♀; 13 Apr. 1959, 10 ♀♀, 3 ♂♂; 20 Apr. 1959, 1 ♀, 3 ♂♂; 21 Apr. 1959, 3 ♀♀, 1 ♂; 22 Apr. 1959, 1 ♀, 1 ♂; 24 Apr. 1959, 4 ♀♀, 1 ♂ (E. Tindall); ex Carolina wren nest, V–10–60, 1 ♀ (R. Collins). Fox (1940) gave the eastern hosts of this flea as *P. l. leucopus* (Rafinesque) and *M. pennsylvanicus.* Burbutis (1956) also listed *B. brevicauda* and *Mustela frenata noveboracensis* (Emmons) as hosts in New Jersey. Geary (1959) gave an extensive host list of mammals and noted 1 ♀ from a bluebird in New York State. It was reported as the dominant flea of *Peromyscus* in Eastern Canada by Holland (1949).

Orchopeas howardii howardii (Baker).—Faulkland, New Castle Co., ex red squirrel, 20 May 1951, 1 ♂; Newark, New Castle Co., ex red squirrel, 1 ♂ (D. MacCreary); Thompsonville, Kent Co., ex *S. c. pennsylvanicus,* 23 June 1959, 9 ♀♀, 5 ♂♂ (R. F. Darsie). MacCreary (1945a) reported this flea as *Orchopeas wickhami* Baker from the red squirrel. Burbutis (1956) noted the gray squirrel as its preferred host in New Jersey. He also found it to parasitize the opossum, *D. m. virginiana* Kerr, the raccoon, *Procyon lotor* (Linnaeus), and the red squirrel *T. hudsonicus.* Geary (1959) listed a variety of hosts for *O. h. howardii.* This, however, is the first time it has been recorded on the gray squirrel from Delaware.

Pulex irritans irritans Linnaeus.—Hartly, Kent Co., ex abandoned poultry house, 9 June 1960, 5 ♀♀, 3 ♂♂ (D. MacCreary).

Fox (1940) included a variety of hosts for this flea, but Geary (1959) reported it taken from man alone. Although it has been recorded from surrounding states, including nearby Oxford and Chadds Ford, Pennsylvania (Fox), this is the first record from Delaware.

Stenoponia americana Jordan.—Newark, New Castle Co., ex *P. l. noveboracensis,* 2 Mar. 1959, 1 ♀; 18 Mar. 1959, 3 ♀♀, 1 ♂; 20 Mar. 1959, 1 ♂; 13 Apr. 1959, 1 ♀ (E. Tindall). New Castle Co., ex *B. brevicauda,* April, 1939, 1 ♀; Hockessin, New Castle Co., ex *Peromyscus,* Nov. 1939, 1 ♂ (MacCreary). Fox (1940) gave as eastern hosts: *Evotomys* spp., *P. l. noveboracensis, M. p. pennsylvanicus,* "cotton-mouse," *Zapus hudsonius hudsonius* (Zimmerman) and the "Norway-rat." MacCreary (1945a) also reported it from *M. p. pennsylvanicus.* Burbutis (1956) found this flea to parasitize also *B. brevicauda* and *M. pinetorum.*

The association of ectoparasites with each other on the same host animal was determined for the 32 deer mice sampled; see

Table 2. Record of Association of Ectoparasites on the host *P. leucopus,* Delaware, 1959

Species	*B. simplex*	*Eu. peromysci*	*H. carnifex*	*Resinacarus* spp.	*H. glasgowi*	*H. hesperomydis*	*D. blarinae*	*E. wenmanni*	*O. leucopus*	*S. americana*
B. simplex	X*	1			1	1				
Eu. peromysci		5	1	1	12	11	2	5	10	3
H. carnifex			X		1	1			1	
Resinacarus spp.				X		1			1	
H. glasgowi					1	8		4	8	
H. hesperomydis						X	1	3	7	2
D. blarinae							X			
E. wenmanni								X	6	1
O. leucopus									1	2
S. americana										1

* "X" denotes that the parasite was never found occurring alone on the host.

Table 2. *Eu. peromysci* was the most abundant ectoparasite collected; occurring the greatest number of times in association with other species on the host. It was found alone a greater number of times than any other ectoparasite. *H. glasgowi, H. hesperomydis* and *O. leucopus* also appeared with other species in many instances. Of the fleas, *O. leucopus* and *E. wenmanni* were associated most often; however, the mice were much more heavily infested with the former.

List of the Siphonaptera of Delaware and Their Hosts

This is the initial listing of the fleas of Delaware and their hosts, and although it is not the result of an exhaustive study of the order it seems appropriate to consolidate the information which is on hand for the benefit of future workers in the group. To date 14 species of Siphonaptera have been taken from 13 hosts. All are from mammalian hosts, except *Ceratophyllus gallinae* (Schrank), the European chicken flea. Details of this species in Delaware were given by MacCreary and Catts (1954).

Cediopsylla simplex (Baker)
  Marmota monax monax (L), woodchuck
  Sylvilagus floridanus (Allen), cottontail rabbit
Ceratophyllus gallinae (Schrank)
  Gallus gallus Linnaeus, chicken
Ctenocephalides canis (Curtis)
  Canis familiarus Linnaeus, dog
Ctenocephalides felis (Bouché)
  Homo sapians Linnaeus, man
Ctenophthalmus pseudagyrtes Baker
  Blarina brevicauda (Say), short-tailed shrew
  Microtus p. pennsylvanicus (Ord), meadow vole
  Microtus p. pinetorum (Lec), Pine vole
  Peromyscus l. leucopus (Raf), white-footed mouse
  Sylvilagus floridanus (Allen)
Doratopsylla blarinae C. Fox
  Blarina brevicauda (Say)
  Peromyscus l. leucopus (Raf.)
Epitedia wenmanni (Rothschild)
  Peromyscus l. leucopus (Raf.)
Megabothris asio asio (Baker)
  Microtus p. pennsylvanicus (Ord.)
Odontopsylla multispinosus Baker

Sylvilagus floridanus (Allen)
Didelphis virginiana Kerr, opossum
Orchopeas howardii howardii (Baker)
Tamiasciurus hudsonicus loquax (Bangs), red squirrel
Sciurus carolinensis pennsylvanicus Ord., gray squirrel
Orchopeas leucopus (Baker)
Microtus p. pinetorum (Lec.)
Peromyscus l. leucopus (Raf.)
Oropsylla arctomys (Baker)
Vulpes fulva fulva Desmarest, red fox
Marmota monax monax (L.)
Pulex irritans irritans Linnaeus
Abandoned poultry house
Stenoponia americana (Baker)
Microtus p. pennsylvanicus (Ord.)
Microtus p. pinetorum (Lec.)
Peromyscus l. leucopus (Raf.)

Summary

As a result of this study, seven new ectoparasitic species records and three new host records have been added to those already reported for Delaware. In addition a Siphonaptera host list has been compiled for the species of fleas known to occur within the State. The following species of ectoparasites are new records for the State: *Blarinobia simplex* (Ewing), *Euschongastia blarinae* (Ewing), *Euschongastia peromysci* (Ewing), *Hirstionyssus carnifex* (Koch), *Resinacarus* spp., *Hoplopleura hesperomydis* (Osborn), *Pulex irritans irritans* Linnaeus.

In the spring and fall of 1959, small mammals were trapped from a hardwood forest in Newark, New Castle Co., and examined for ectoparasites. Thirty-nine hosts and an abandoned poultry house yielded a total of 773 ectoparasites. Species association, host-parasite relationship, and literature citations to more detailed accounts accompany each record.

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